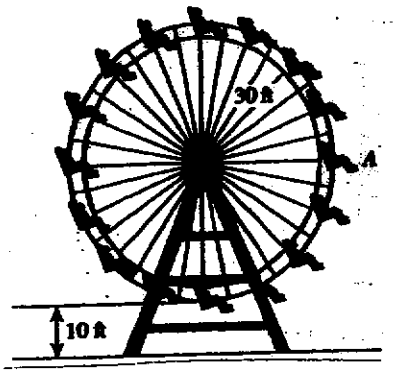
Parametric Equations and Projectile Motion

1. Riding On a Ferris Wheel: You are riding on a Ferris wheel with a radius of 30 ft. The wheel is turning counterclockwise at the rate of one revolution every 10 seconds. Assume the bottom of the Ferris wheel is 10 ft above the ground and at time **t=0**, you start at the point A on the figure. Find parametric equations to model your path while riding the Ferris wheel. What position would you be in 22 seconds into the ride?



New Concept: It can be shown (using calculus), that if an object is thrown (or launched) vertically into the air from an initial height s_0 ft above the ground with an initial velocity of v_0 ft/sec, then the height of the object t seconds after it is thrown can be represented by the function:

$$s(t) = -16t^2 + v_0t + s_0$$

2. Modeling the Motion of a Ball: From the top of a building 30 feet high a ball is thrown vertically upward with an initial velocity of 50 ft/sec.

a. Write the function that models the height of the ball as a function of time.

b. Graph the function and find how high the ball travels.

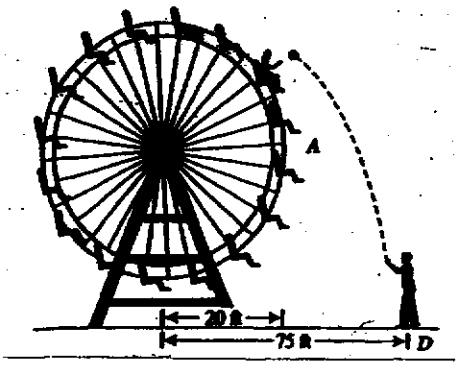
c. Model the motion of the ball with parametric equations.

New Concept: How could we simulate the motion of the ball if it was not thrown straight upward, but at an angle θ degrees with the horizontal?

d. If the ball in the example is not thrown vertically upward, but at an angle of 65°, model the motion of the ball with parametric equations. Find how high the ball travels and how far the ball travels horizontally.

3. **Hitting a Baseball:** Troy Tulowitski, of the Colorado Rockies, hits a baseball when it is 3 ft above the ground with an initial speed of 150 ft/sec at an angle of 19° with the horizontal. Will the ball clear a 20 ft high wall that is 400 ft away?

4. **Throwing a Ball at a Ferris Wheel:** A Ferris wheel with a radius of 20 ft turns counterclockwise one revolution every 12 seconds. A boy stands at a point 75 ft from the base of the wheel. At the instant that a girl riding the Ferris wheel is at point A, the boy throws the ball at the Ferris wheel, releasing it from the same height as the bottom of the wheel. If the ball's initial velocity is 60 feet/sec and it is released at an angle of 120° with the horizontal, does the girl have a chance to catch it?



a. Write and graph the parametric equations for both the motion of the girl on the ferris wheel, and the ball thrown by the boy.

b. Trace on your graphs (simultaneous) to find the time and the x-value and y-value of the point where the ball is closest to the girl.

t = _____ Ball:(_____ , _____) Girl: (_____ , _____)

c. Use the Distance Formula to find the distance between the ball and the girl when the ball is closest to the girl.

Distance = _____